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Document title : Proposal of Integrated AAM for Mechanical Design Manufacturing(2)

ABSTRACT:

This document is proposal of Integrated AAM for Mechanical Design and Manufacturing. This Integrated AAM is detail about Develop Product activity and Design Machining Process activity.

KEYWORDS:

AAM

Mechanical Design and Manufacturing

Design machining process

Machining Process Data Model

Assembly Feature Data Model

COMMENTS TO READER:

This document is a proposal of AAM for Mechanical Design and Manufacturing process.

And this document was presented at New Orleans ISO meeting.

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1. Background

We have investigated the data model to develop and manufacture mechanical product. Our main concern is how to deal with the data model through whole process of mechanical product life cycle. And our goal is to develop the technology and establish a standard for consistent data model of mechanical manufacturing process system.

At the SC4 San Francisco meeting in January 1999, we presented "Proposal of Integrated AAM for Mechanical Design and Manufacturing (TC184/SC4/WG3 N773)". In that document, we pointed out the following requirements by analyzing the whole process.

(1) Need information for process chain
(2) Development of Data model (APs) to support the consistency between mechanical design and manufacturing.
(3) Separation of AP domains.

We surveyed several related ISO standards from ISO10303, ISO14649, ISO15531 and so on. These results were induced by analyzing AAM (Application Activity Model) of whole mechanical process. When we investigate and analyze the requirements, we adopt the fundamental STEP development methodology defined by STEP AP development guideline.

This time we investigate the detail relationship of Develop Product Process output, Design Machining Process and Design Assembly Process. In this document we will explain the detail Design Machining Process for process planning and operation planning, and emphasize the difference between Product Model Data, which is output of Develop Product Process, and Machining Process Data Model used for Design Machining Process.

2. Conclusion

We recognize the importance of different handling of model data between Develop Product process and Design Machining process. As follows, we depict data model and its process activity and its expected functional requirements.

(1) Machining Process Data Model

[The positions]

- Table 1. "Proposed machining Process Data Model" shows the difference between Machining Process Data Model and other existing models.
- This new model can represent process planning and operation planning data.
- If the Form Feature of AP224 intend to be applied for Machining Process Data, we need discuss in detail.

[The Functions]

1)Design Machining Process (A2):

- By using Product Model Data (output data model of Develop Product Process activity) and Model Data of Existing Machining Line, it can induce Process and Operation Planning Data.

2) Design Machining Line and Create Process Plan for Machining (A22):

- By using Form Feature based Product Model Data and Model Data of Existing Machine Line, it can induce Process and Operation Planing Data and Manufacturing Feature based Product Information.

(A223,A225,A2231,A2232,A2233,A2235,A2251,A2252,A2253 will be explained later documentation.)

(2) Assembly Feature Data model

[The Functions]

1) Design Assembly Process (A3) :

- By using Model Data of Existing Assembly Line and Manufacturing Resource Data Model, it can get Tool requirements, Model Data of Assembly Line, Operation Planning Data for Assembly.

2) Capture Assembly Feature (A31) :

- By using Product Model Data, it can induce Assembly Feature Based Model Data

3. Summary

- From this investigation, we propose the need of data model, which can be used in the design machining process activity related product model data.
- For process and operation planning of Mechanical product, we must recognize the difference among Product Model Data, Machining Process Data Model and Data Model for Computerized Numerical Controller.

Table 1. Proposed Machining Process Data Model

	A	**B**	C
	ISO 10303 **STEP AP224**	**Machining Process Data Model**	ISO 14649 **CNC Data Model** Part11
Category	Data Model for **Input** to CAM	Data Model for **Output** from CAM	
Usage	Product Definition for Process Planning	Data Model for Describing Results of Process and Operation Planning	Data Model for Computerized Numerical Controllers
Name of Feature for Manufacturing	**Form Feature** (categorized by finished shape of Features)	**Manufacturing Feature** (categorized by finished shape of Features and **Delta Volume**)	**Manufacturing Feature** (categorized by finished shape of Features)
Stock Removal	Expression for Workpiece	Expression for **Each Feature**	Expression for Workpiece
Feature Relationship	Expression between Geomeries	Expression between **Features**	None
Geometry	Workpiece and Feature Geometry (**B-rep Model**)	Feature Geometry	Feature Geometry
Tolerance	Dimensional and Geometric Tolerance (**Attributes of Geometry**)	Dimensional and Geometric Tolerance (**Attributes of Feature with Simplified Expression**)	Dimensional Tolerance only for Length
Process Planning Data	None	**Machining Process Data** for Milling and Turning	None
Workingstep Data for Operation Plan	None	・ Two5D Milling Operation ・ Drilling Type Operation ・ Turning Operation	・ Two5D Milling Operation ・ Drilling Type Operation ・ Freeform Milling Operation
Reference Data Models		・ CNC Data Model (ISO 14649) ・ Cutting Tool Model (ISO 13399) ・ Machine Tool Model (NIST Model)	・ Cutting Tool Model (ISO 13399)

1-1. Automatic Conversion can be done from A to B except Process Planning Data and Workingstep Data.

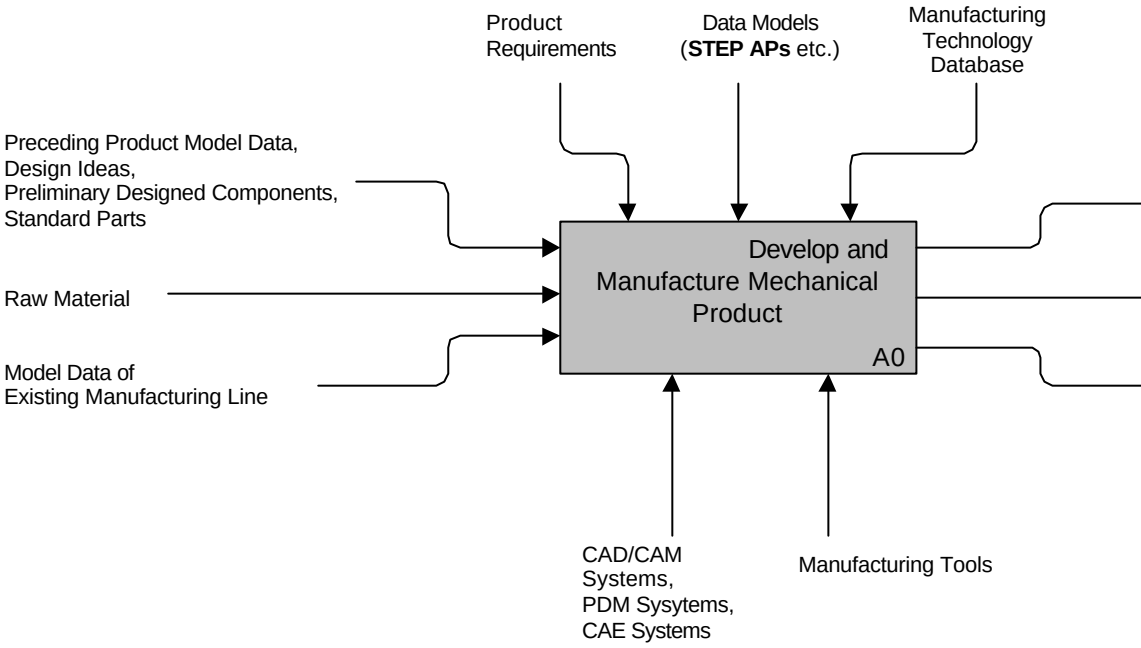
1-2. Automatic Conversion can be done from B to C. [Data Model B includes Data Model C]

2. STEP AP213 (NC Process Planning) is the Data Model for describing mainly Management Data , not Engineering Data.

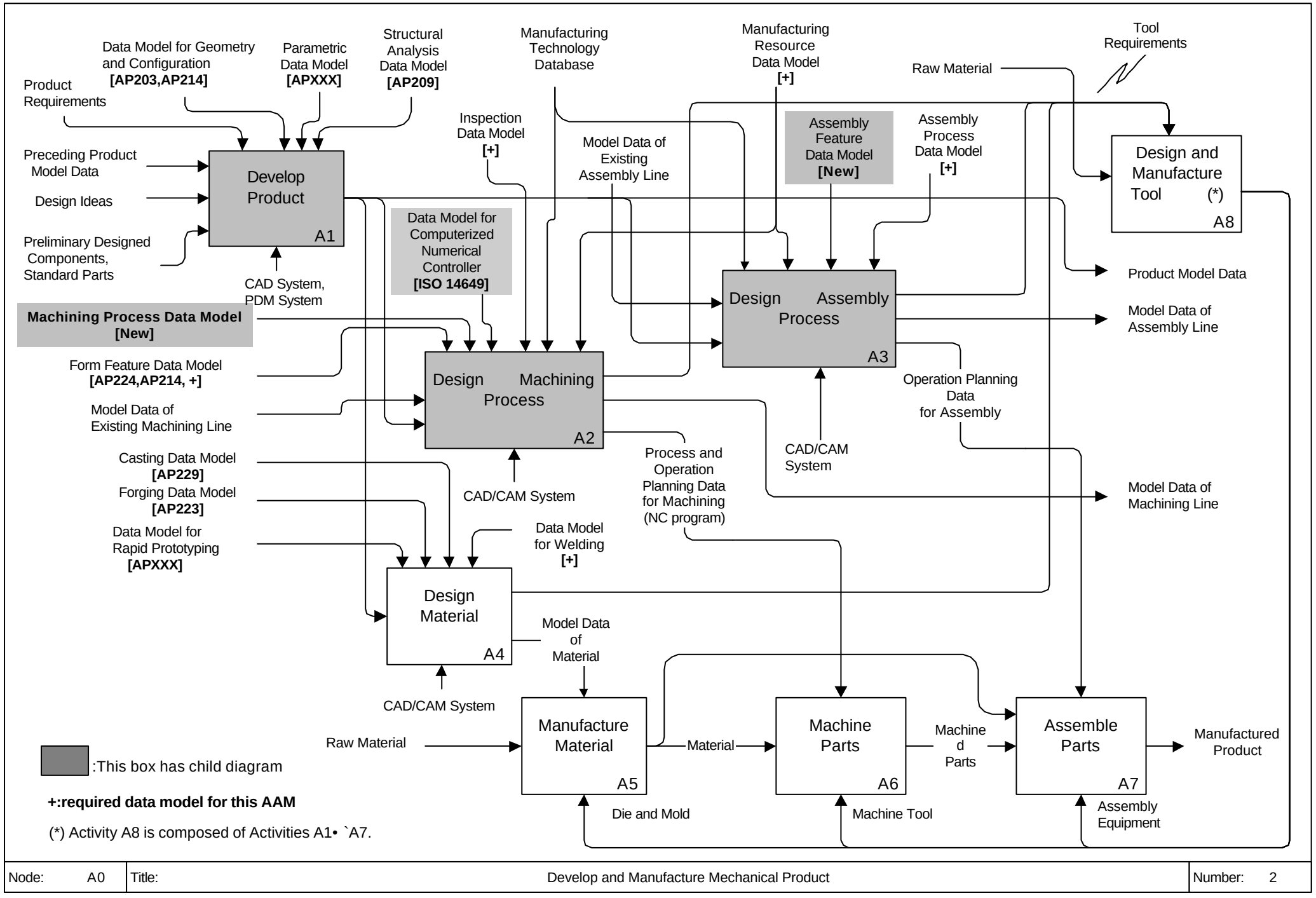
Integrated AAM on Engineering :

Develop and Manufacture Mechanical Product

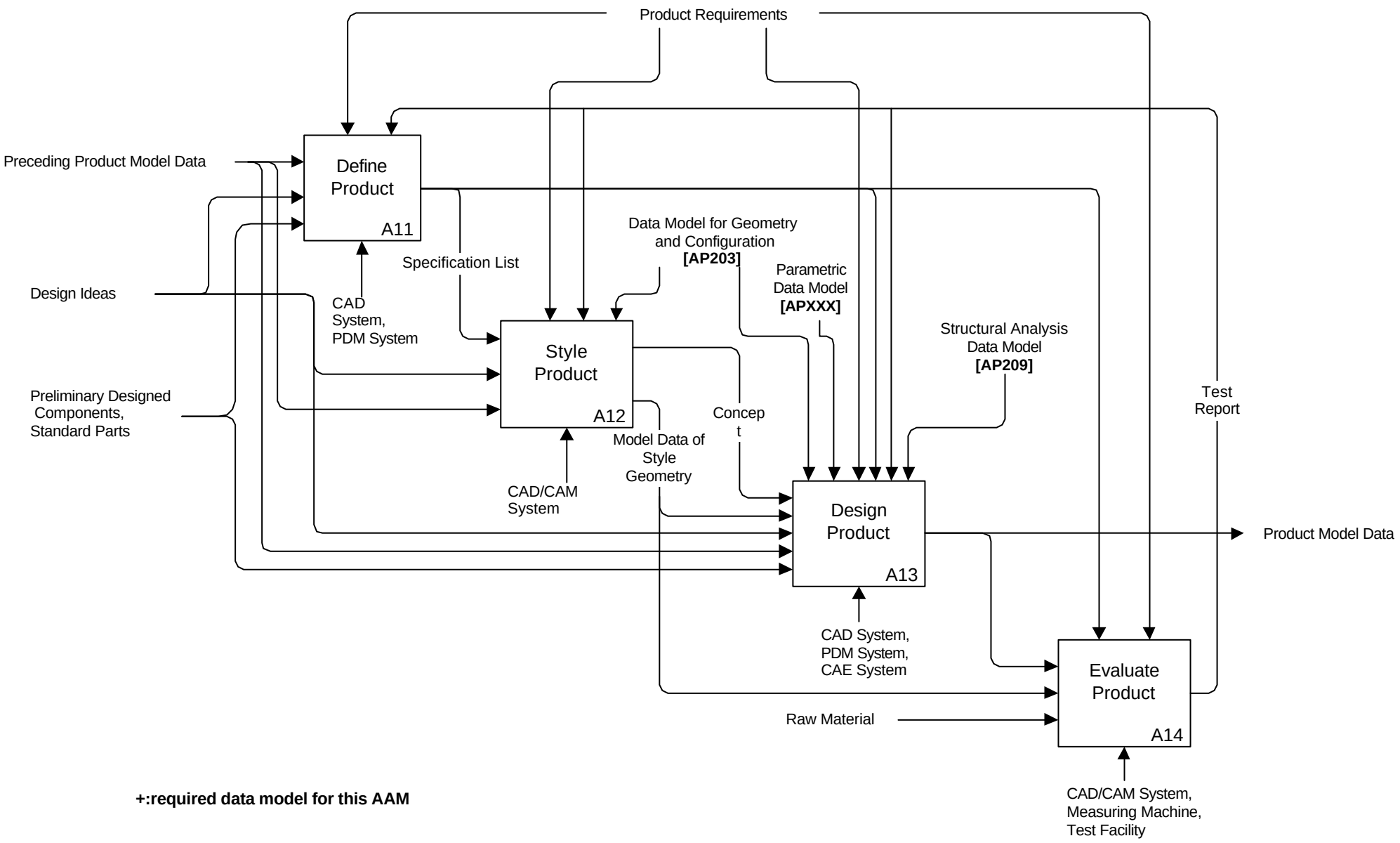
Node:	Title:	Number: 0



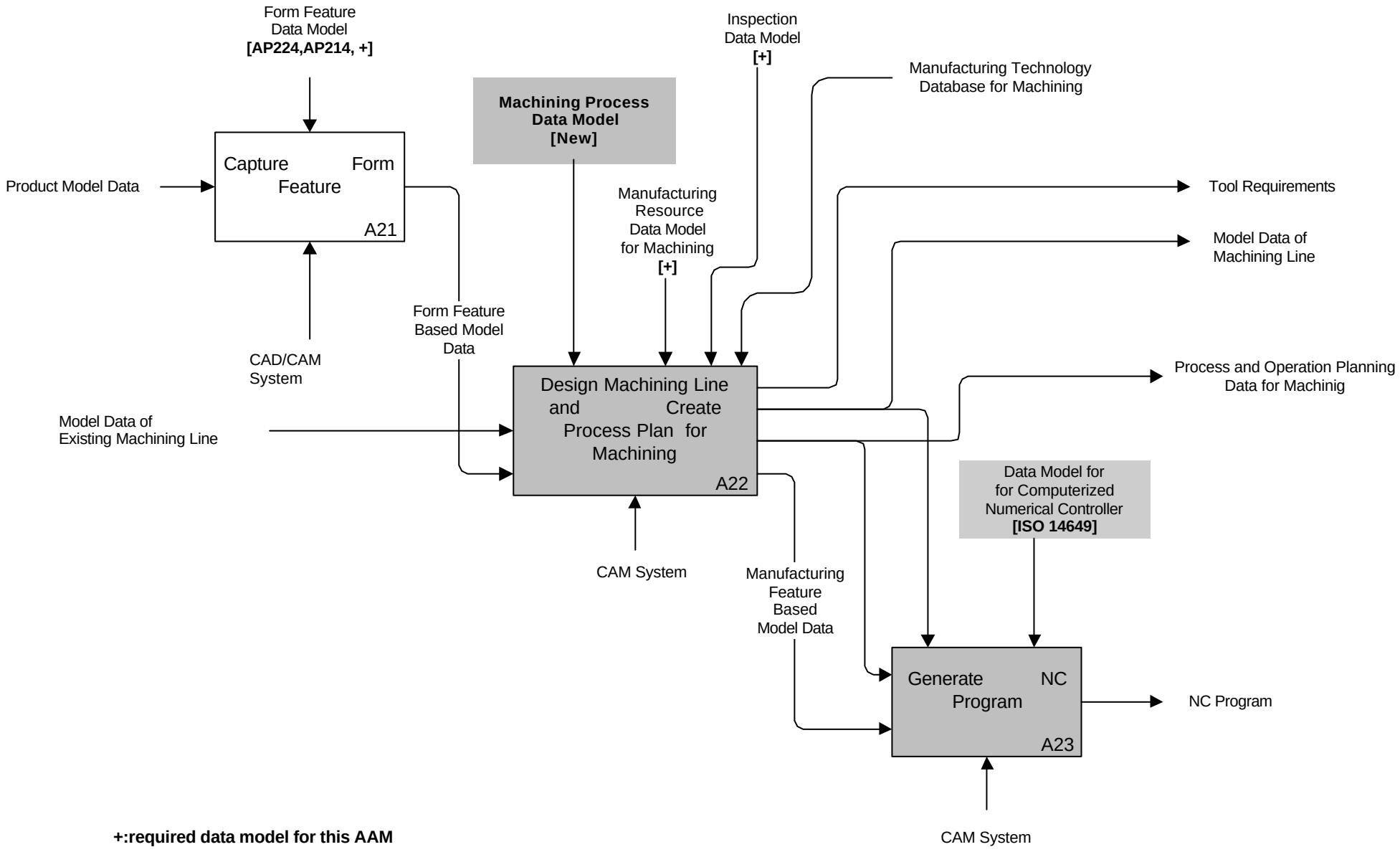
Node:	Title:	Integrated AAM on Engineering to Develop and Manufacture Mechanical Product	Number: 1



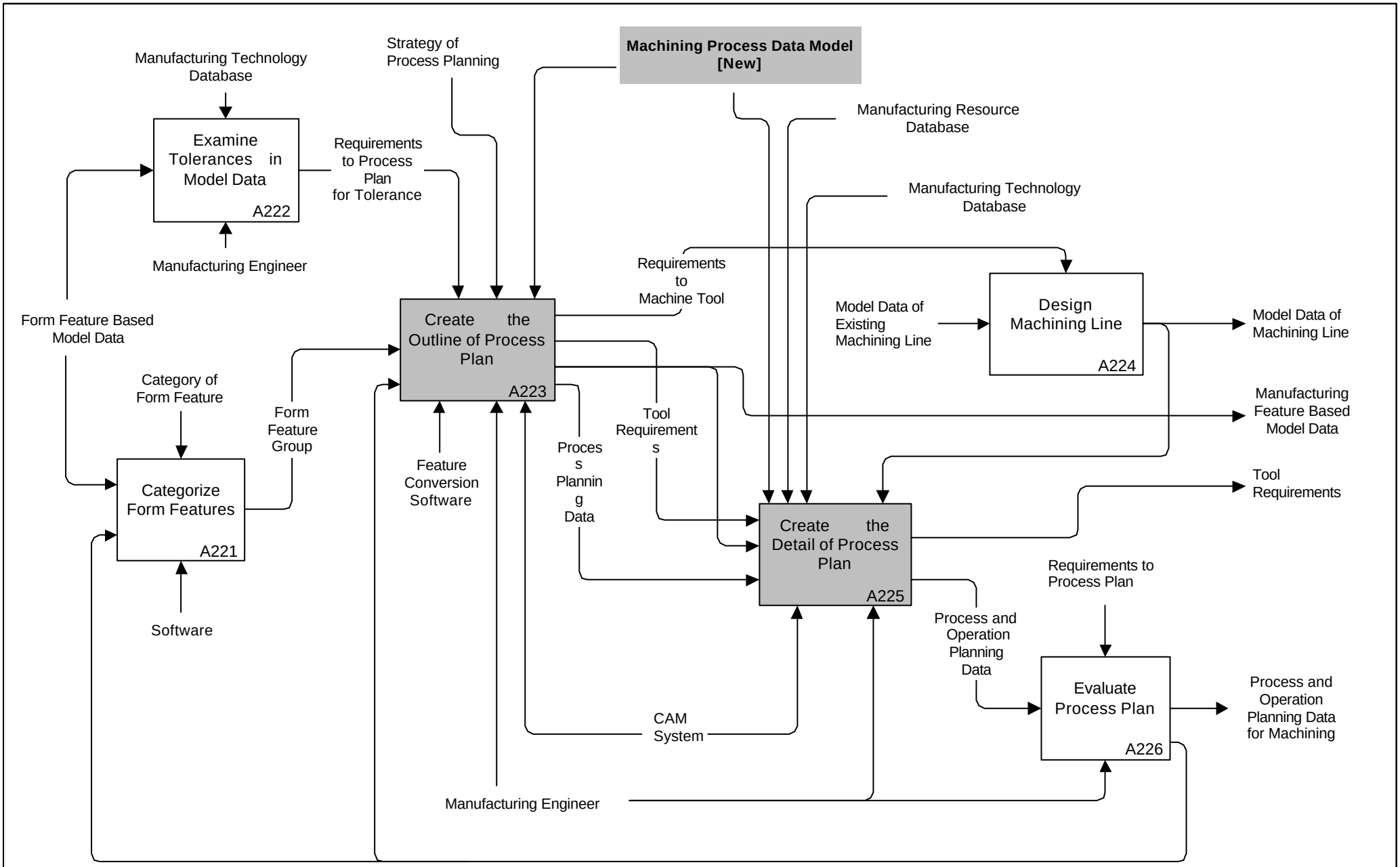
Node: A0	Title: Develop and Manufacture Mechanical Product	Number: 2



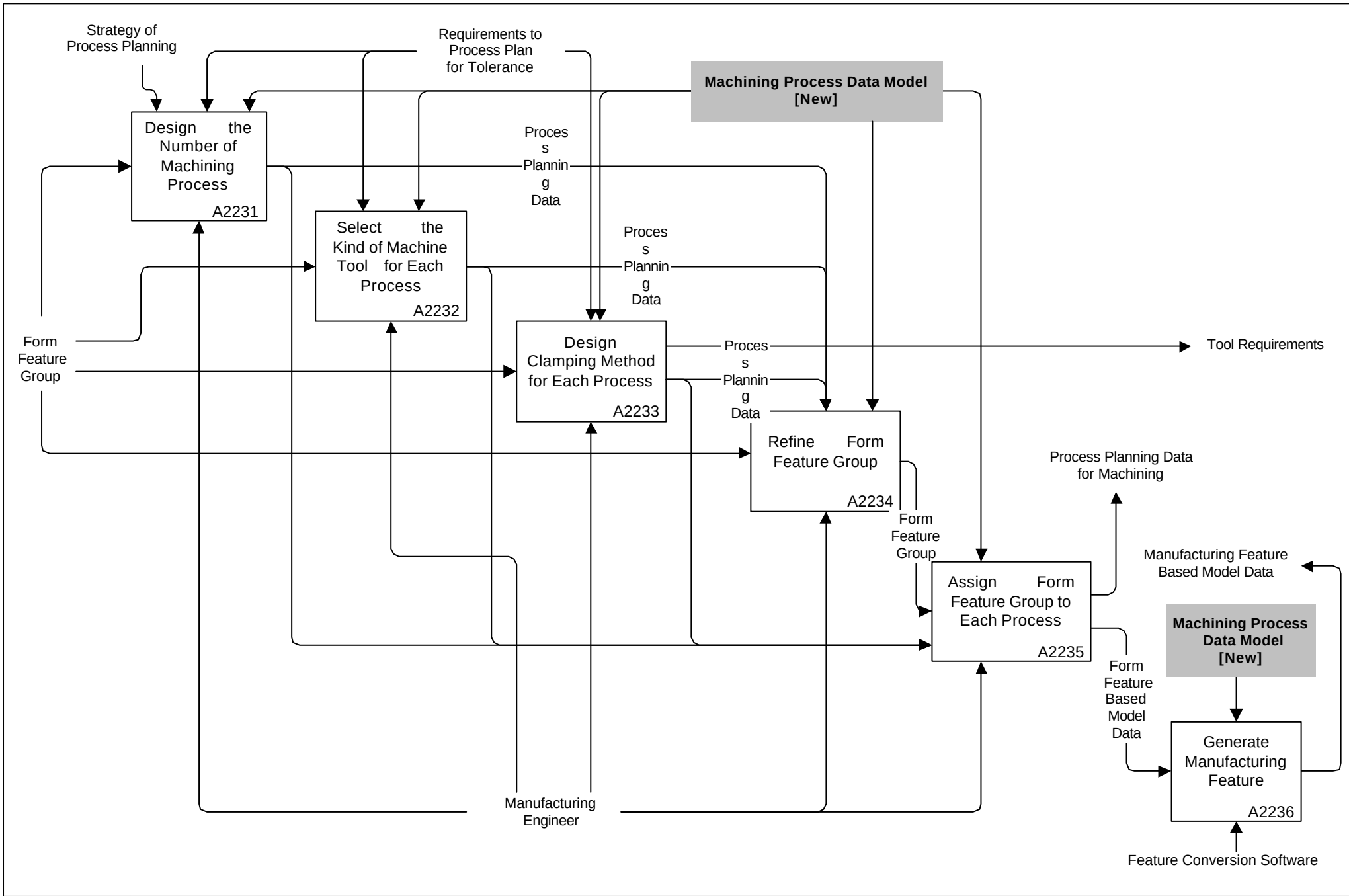
Node: A1	Title: Develop Product	Number: 3



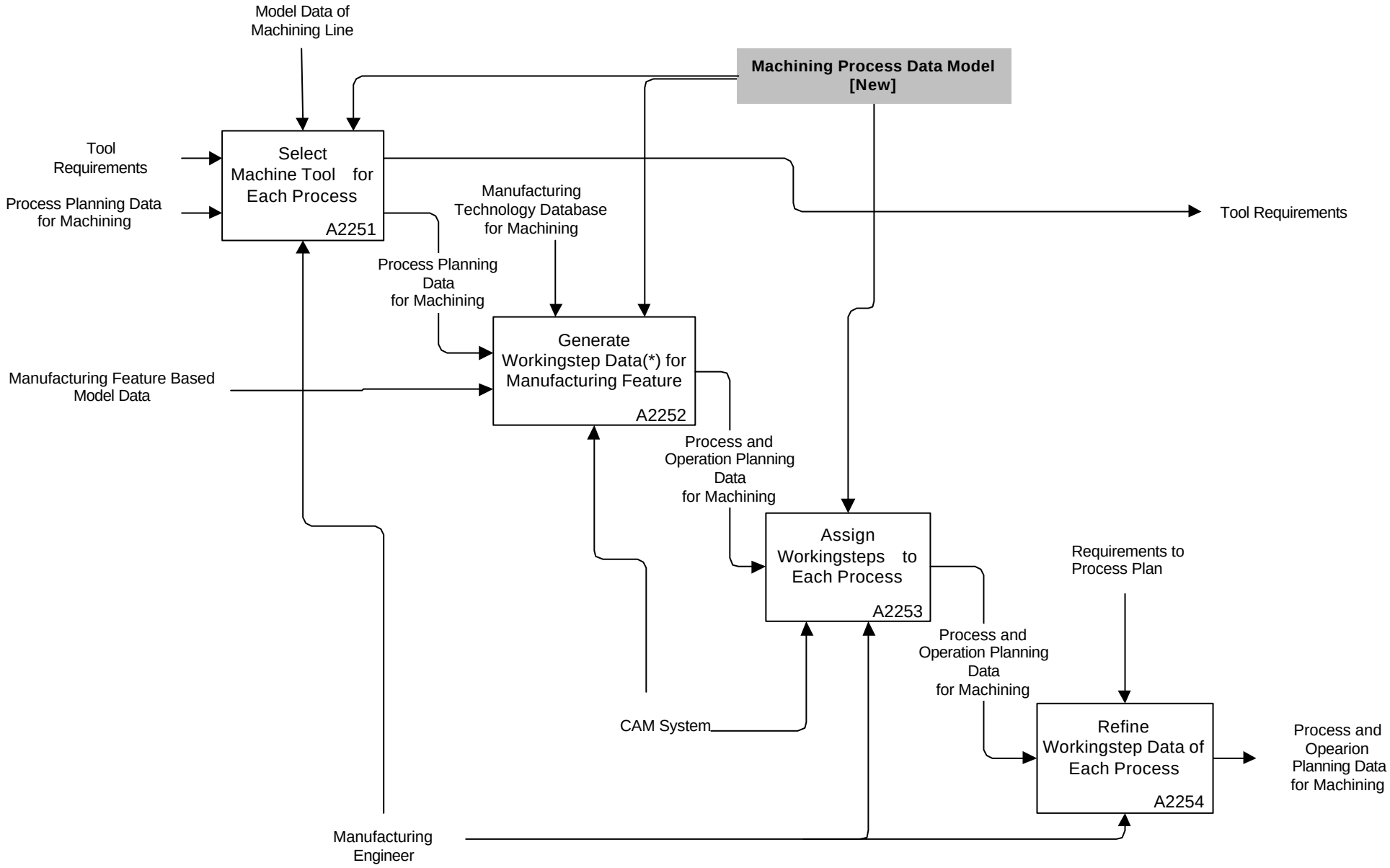
Node: A2	Title: Design Machining Process	Number: 4



Node: A22	Title: Design Machining Line and Create Process Plan for Machining	Number: 5

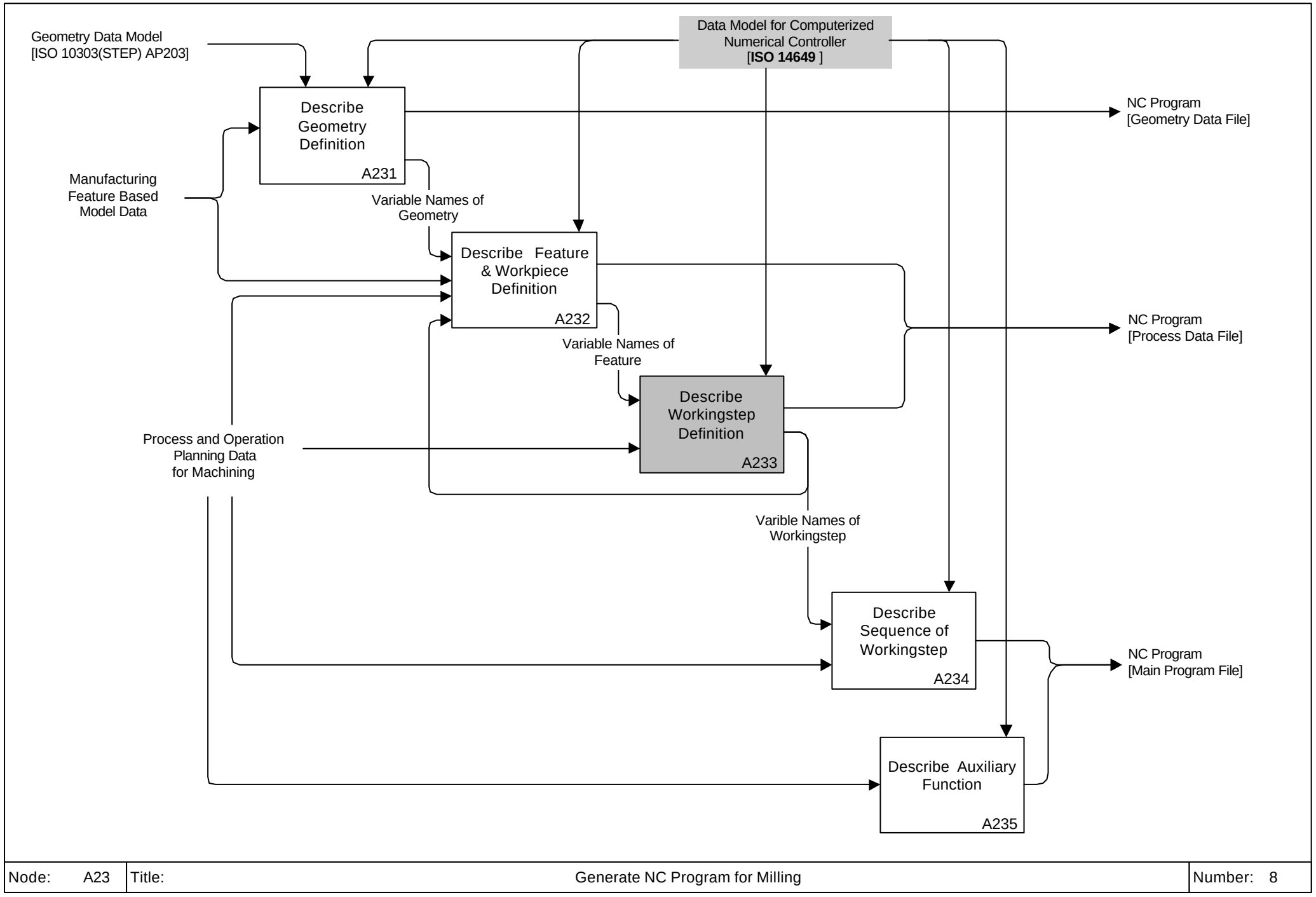


Node: A223	Title: Create the Outline of Process Plan	Number: 6

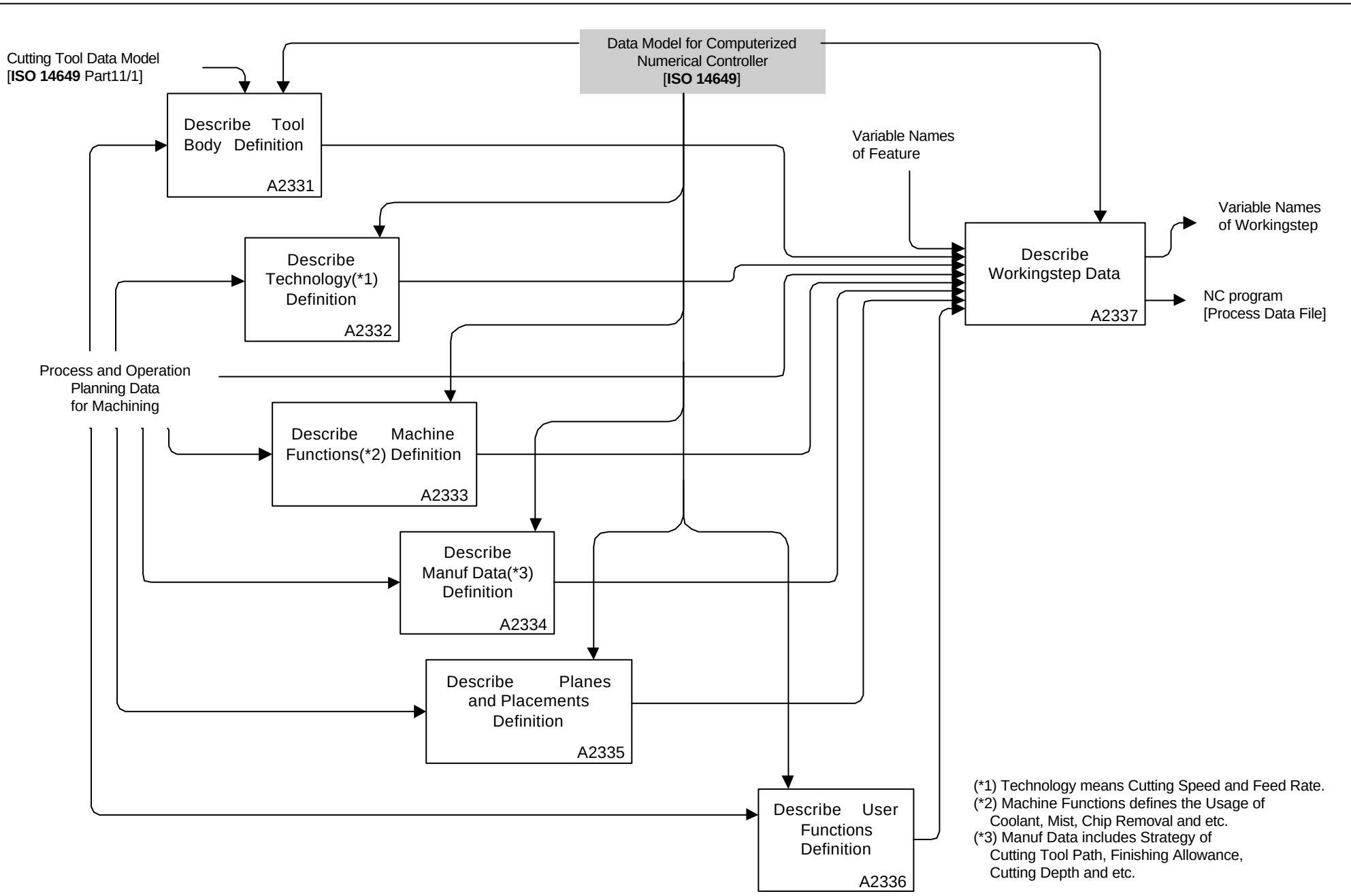


(*) Workingstep Data is shown in the Page 9.

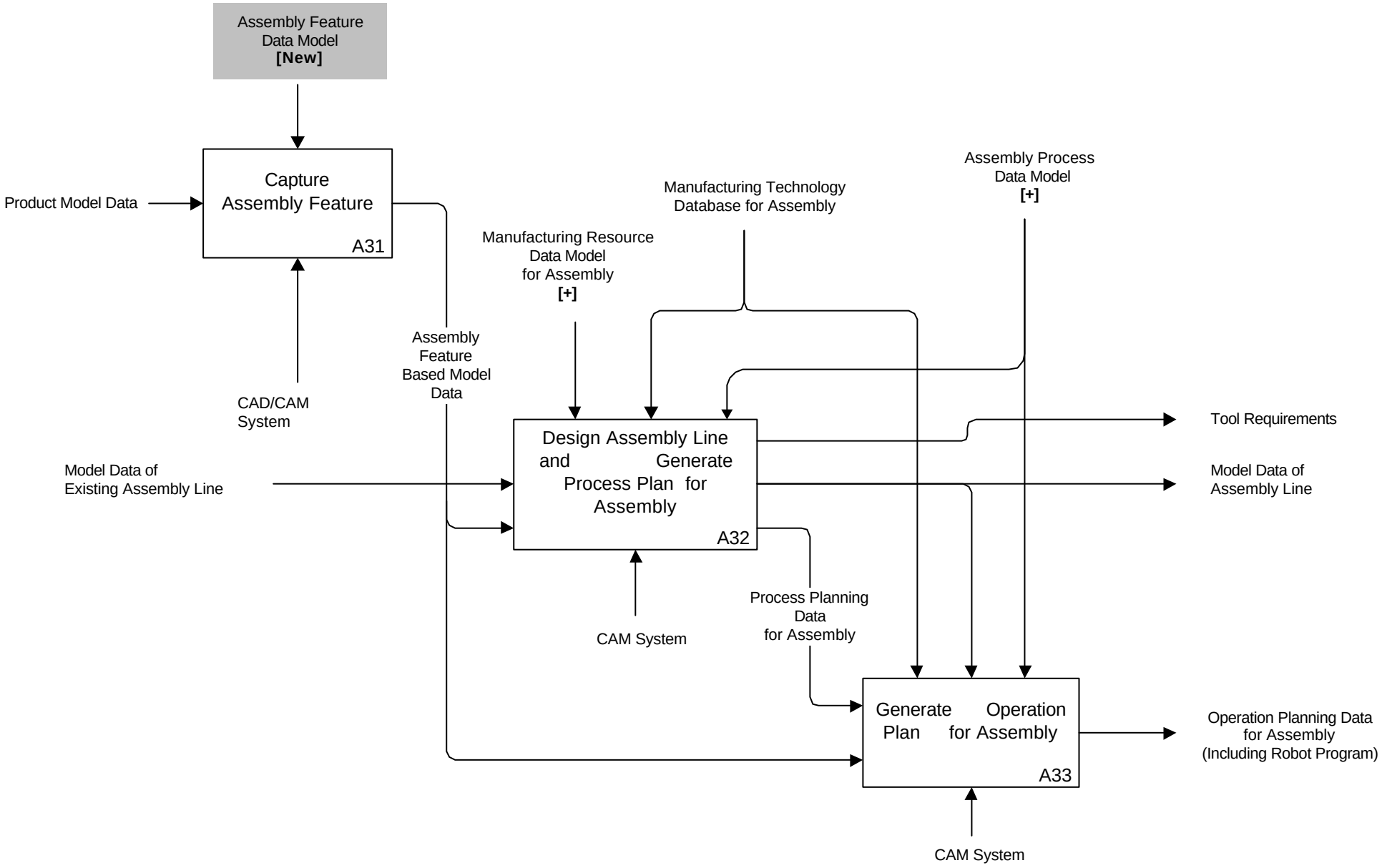
Node: A225	Title: Create the Datail of Process Plan	Number: 7



Node: A23	Title: Generate NC Program for Milling	Number: 8



Node: A233	Title: Describe Workingstep Definition	Number: 9



Node: A3	Title: Design Assembly Process	Number: 10